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Abstract

A total educational information system for evaluation of vocational education in Massachusetts is described. Specifically, the evaluation guide describes the evaluation plan, reveals the philosophy of evaluation upon which the design was built, outlines the processes of evaluation called for in the design, introduces the forms for data collection that will be used in the design, and acts as a reference manual for those persons at the local level responsible for conducting specified segments of the design. The system is presented in four phases: (1) Program Evaluation, (2) Process-Product Evaluation, (3) Cost-Benefit Evaluation, and (4) Evaluation of Vocational-Technical Education (Impact Study). (CH)

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A GUIDE TO EVALUATION

MASSACHUSETTS INFORMATION FEEDBACK SYSTEM FOR VOCATIONAL EDUCATION

First Technical Progress Report
September 1969

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INTRODUCTION

This publication is essentially a technical report describing the development of a total educational information system for vocational education in Massachusetts. A multi-audience on both the state and national level has been considered in drafting the publication, including: vocational educational administrators on the federal, state, and local levels; vocational education teachers; students of vocational education; research and evaluation specialists; and the concerned lay public. Our staff would be delighted to respond to any inquiries concerning developments relating to any phase of the total educational information system.

Both the Massachusetts Information Feedback System and this publication owe their existence to the genius and tireless efforts of Jim C. Fortune, University of Massachusetts.

William G. Conroy, Editor

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION

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PREFACE

The evaluation of Vocational-Technical Education is a primary concern of Congress and those charged with the responsibility of administering Vocational-Technical Education, as are other programs partially or fully supported by Federal dollars. Public Law 90-576, Amendments to the Vocational Education Act of 1963, states that the State Advisory Committee shall "evaluate vocational education programs, services, and activities assisted under this title and publish and distribute the results thereof: and prepare and submit an annual evaluation report, accompanied by such additional comments of the State Board as the State Board deems appropriate, which (1) evaluates the effectiveness of vocational education programs, services and activities carried out in the year under review in meeting the program objectives set forth in the long-range program plan..."

During its November, 1968 conference the Vocational

Education Research Initiation Team of the Research Coordination Unit for the Commonwealth of Massachusetts determined that the development of an evaluation process for Vocational-Technical Education was the second most crucial issue (second only to the education of the disadvantaged) facing Vocational-Technical Education at this time in the state.

Acting under the auspices of the new amendment and the stated concern and need by the Research Initiation Team, the Research Coordination Unit of the Commonwealth of Massachusetts has attempted to design a state-wide evaluation that will (1) fulfill the criterion of providing a state-wide data base for the assessment of Vocational-Technical Education programming, (2) meet the needs of local institutions in terms of offering viable feedback upon their programs, (3) continue to grow and be flexible enough to meet the increasing needs for evaluation caused by program growth, (4) gather data on the three most essential aspects of Vocational-Technical Education, namely, product, process and cost, and (5) allow for decision-making at the local as well as at the state level. The evaluation guide seeks to: (1) describe the evaluation plan, (2) reveal the philosophy of evaluation upon which the design was built, (3) outline the processes of evaluation called for in the design, (4) introduce the forms for data collection that will be used in the design, and (5) act as a reference manual for those persons at the local level responsible for conducting specified segments of the design.

CHAPTER ONE

INTRODUCTION TO EVALUATION

Jim C. Fortune
University of Massachusetts

Analysis of Current Practices

Evaluation in education has failed to develop as rapidly as other phases of the educational process because educators have only partially adopted scientific methodology. This failure to adopt scientific methodology is due in part to the nature of the variables with which educators must deal, in part to the types of people which enter into the educational profession, and in part to the mistrust and misconceptions existing in the field concerning empiricism and more specifically evaluation.

The evaluation of educational programs has often been confused with justification and the judgment component of evaluation has been viewed by educators as a threat. Even though the major charge of evaluation, according to current thinking, is to provide data needed for decision making, the required evaluation of funded programs has led educators to confuse evaluation with refunding criteria. Hence, program administrators have felt it necessary to show goal attainment as a basis for refunding, making evaluation a post hoc operation which is primarily concerned with searching for positive program effects after the program has been completed. This use of evaluation in an after-the-fact manner robs evaluation of its most potential benefits and places the evaluator in a role of having to pass judgment upon a program which cannot be altered from the information produced. In viewing evaluation as a post hoc operation of which results can do little to alter the effectiveness of a program or to point out weaknesses of the program in time for them to be corrected, the program personnel are threatened by the finality of the results and must reject evaluation as invalid in order to protect their ego-investment. With, however, the absence of a commonly-agreed-upon criterion for "good" teaching and with the inferential nature of variables related to behavior change, the threatening aspects of value judgments based upon post hoc evaluation become understandable. Such threats can easily be erased, however, by applying evaluation as a feedback mechanism rather than a post hoc operation, allowing evaluation to offer directions for program modification and operation.

The structure of public education has also been the basis for mistrust and misconceptions concerning evaluation. The rigidity of the structure of the public education system, at times, inhibits proper evaluation processes and makes evaluation difficult if not impossible. The public nature of education has tended to put educators on the defensive and has made them feel the need to overly justify their efforts hindering the communication needed for proper evaluation. The time demands and public pressures placed upon educators have not allowed them to spend the necessary time required to plan and carry out effective evaluation. Program commitments and the inflexibility of program design leaves little room during the process for effective modifications. Previous practice of only paying lip-service to evaluation has left the field of practitioners with remembrances of the ineffectiveness of the evaluation process. The practice of justifying programs through the testimonies of experts and through the sanction of accreditation agencies have led educators to believe that these activities fulfill the evaluation needs of a program without ever questioning the kinds of effects the program has on students or on staff.

Up to the present time, teachers, administrators and counselors have received their training in evaluation techniques on a piecemeal basis. Some of their training was received in courses in tests and measurements; some of their training was acquired in educational statistics and psychology courses; and other parts of their training were tacked on to methods courses. This piecemeal approach to the development of evaluation skills has generally been unsatisfactory. Educators of the field are normally poor evaluators, part of which is due to the inability to synthesize the varying fragments of training into functional skills. There are often few attempts to analyze what standardized tests measure. Very seldom is there any effort made to see whether or not the items on locally-made tests communicate clearly. Usually, evaluation procedures for instructional programs take place only at the end of the program, too late to become part of the decision-making feedback process which should be an integral part of evaluation. Too often single-measures possessing little resemblance to terminal behaviors (because paper and pencil tests seem to be the easiest route to criterion evaluation) are used and contextual variables are often ignored.

Confusion in regard to purposes and usefulness of evaluation has generated a lack of confidence in the ability to evaluate programs functionally. Heavy commitments of personnel limit the amount of time they have to evaluate their efforts adequately. The difficulty of assigning causal relations to variables and of identifying cost factors of programs have left program decisions for revision and selection in the realm of mysticism.

Review of current thinking

Curriculum revisions, new designs in teacher education, and other innovative programs are evidence of the search to improve education. Inherent in these attempts is the assumption that the status of the education system is known and that its inadequacies can be empirically identified. These attempts to improve instruction and instructional processes, however, have served to spotlight evaluation weaknesses and indicate that most educational improvement programs are carried out on a trial and error basis. Without the ability to diagnose student capabilities and needs, without the ability to measure and describe program outcomes, without the ability to compare alternative programs, there exists little basis for directed improvement. In "Learning for Mastery" Bloom (1968) posits:

> There is little question that the schools now do provide experience for some students--perhaps as high as one-third of the students. If the schools are to provide successful and satisfying learning experiences for at least 90 per cent of the students, major changes must take place in the attitudes of students, teachers, and administrators; changes must also take place in teaching strategies and in the role of evaluation.

The needed changes in evaluation perceived by Bloom have been adequately pointed out and described by Guba (1968) and by Stufflebeam (1968). In order that evaluation serve better the needs of education, it must become a more active part of the process of change. Evaluation must become an important activity in decision-making. Feedback for curriculum revision should come from evaluation. Curriculum choices should be based upon data generated for evaluation. Hence, the evaluation needs of the education system are more than the limited tests and measurement skills usually offered. Evaluation must become more than the quickly gathered "after-the-fact" data selected to justify a program. Evaluation must become descriptive, active, and better utilized in the schools.

In the training of personnel to carry out evaluation in today's school programs, the emerging role of evaluation must be given more prominence. No longer can education rely on the indirect method of training evaluators through the development of measurement skills. In the early 1930's, tests and measurement were adequate as a beginning of educational evaluation. Lord, however, recognized that tests and measurements were only part of the skills needed in evaluation and that evaluation was a much broader concept. (Pace, 1968). Since teachers and other educational personnel tend not to utilize the tests and measurement skills usually taught in education programs, evaluation skills with easily recognized relevance may be improved and become the route through which educational evaluation can become more useful.

Educators tend to be overburdened with knowledge to be gained and skills to be acquired. Perhaps, evaluation skills should be part of the curriculum for only those who wish or need them in their repertoire, even though we might wish to impart an awareness to all. Specialists and/or technicians may well be able to increase the efficiency of evaluation and to improve the quality and usefulness of evaluation in the improvement of education.

In the establishment of a curriculum and program in evaluation, care must be taken to include all of the skills needed to carry out the broad process called "evaluation". Cronbach (1962) defines "evaluation" as the collection and use of information to make decisions about an educational program. Stake (1967), in describing evaluation, says:

> Both description and judgment are essential--in fact, they are the two basic acts of evaluation. Any individual evaluator may attempt to refrain from judging or from collecting the judgments of others. Any individual evaluator may seek only to bring to light the worth of the program. But their evaluations are incomplete. To be fully understood, the educational program must be fully described and fully judged.

Stufflebeam (1968), working out of the Evaluation Center at Ohio State University, emphasizes the role of evaluation as a tool in decision-making. His analysis breaks evaluation into four categories; context evaluation, input evaluation, process evaluation, and product evaluation. In the so-called CIPP model of evaluation, context evaluation refers to the assessment of variables that determine the school's status, that characterize the school's setting and that are related to the identification of needs and problems. Input evaluation refers to a description of the resources and components available and used in coping with the specified problems. Process evaluation is defined as feedback mechanism used to determine the effectiveness of the program and its individual components. In process evaluation, the educational program of the instructional sequence is evaluated in terms of objective, purpose, and/or a set of operating standards. The fourth breakdown of evaluation is product evaluation, which includes the determination of the feasibility, quality, and efficiency of the program in terms of its product, i.e. students.

Pace (1968) of the Research and Development Center on Evaluation of UCLA prefers a categorization system of evaluation activities organized around the size of the program being evaluated. He is careful to point out that evaluation strategies and the skills needed to carry out the evaluation activities differ significantly as size of unit, scope of unit, and duration of the unit being evaluated vary. For small units (such as programmed tests, instructional methods, or instructional units) relevant evaluation can be directly related to behaviorally defined objectives, largely limited to intended effects, designed as a hypothesis testing experiment, directly criterion based, and largely unconcerned with group processes. For a medium sized unit (such as, a particular curriculum, a single school, or a single grade) relevant evaluation should not be limited to explicitly defined program objectives, but include a range of potential outcomes and interactions, sometimes approximate an experimental mode (controlled conditions for the duration of the program are rarely possible) and be concerned with group processes. For large units (such as a school system, a total institutional program, or higher education in the United States) relevant evaluation should never be designed as an "experiment" and be concerned with group processes only when relevant.

Following is a summary of the major emphases concerning evaluation at this time:

1. There is a need for evaluation to become more descriptive of what is going on in the schools. This information as to what is must be fed back into the system to produce further change (which in turn requires further evaluation). We can no longer view evaluation as completed when the final report is written.

2. Tests and measurements no longer describe evaluation. There is need to train those with evaluation responsibility in new procedures of evaluation to improve the quality and usefulness of evaluation.

3. Evaluation is a tool in decision-making. It describes what is going on. The decision as to what steps to make after the evaluation are often humanistic, existential decisions; but, evaluation makes it possible to define the effectiveness of these decisions.

4. The broad movement of new thinking in educational research appears to be moving toward a process view of evaluation in which evaluation never ends, but is on-going. This process view is meaningful to the conduct of classrooms, special projects and the curriculum in general, and may provide an effective link for the first time between educational researchers and school personnel.

5. The procedures and techniques of evaluation will vary as the scope and size of the evaluation changes. The larger the system, the more a "process" approach to evaluation may be required.

Role of Evaluation - A Basis for Directed Change

As can be seen from the current thinking concerning evaluation, there is a natural role in the instructional process for evaluation. Evaluation serves as the basis for directed change in education. Through evaluation educational programs can be described adequately for replication, diagnosed for strengths and weaknesses, validated for effectiveness, modified and redesigned for efficiency, and judged for relevance and pertinence.

C. Robert Pace in "Evaluation Perspectives: '68," outlines several components of evaluation that indicate the total power of evaluation as a fundamental tool for directed change in education.

1. PRODUCT TESTING: the testing of products to describe their characteristics.

2. INSTITUTIONAL ACCOUNTING: the accumulation of data about an institution's operation--income, expenditures, costs per credit hour, faculty-student ratios, etc.

3. ACHIEVEMENT TESTING: The measurement of pupils' knowledge at the beginning and end of a course.

4. DIAGNOSIS AND ASSIGNMENT: the diagnosis of pupils' present knowledge and skills and the assignment of pupils to individualized instructional treatments.

5. SENSITIVITY TO GROUP PROCESS OR OPENESS TO CHANGE AND ADAPTATION: the procedures one used to facilitate change or innovation and the willingness to modify plans as they are carried out.

6. STUDY OF PERSONALITY DEVELOPMENT: the ways in which pupils' interests, attitudes, values, etc. change over time.

7. STUDY OF INSTRUCTION: the particular interactions between teachers and pupils, and the discovery that certain approaches work with some students and other approaches work with other students.

8. ACCREDITATION: the collection of data and its review by an accrediting agency.

9. DECISION-MAKING: the collection and use of information by administrators for decision-making.

Each of the evaluation components produces relevant and necessary information toward the quality control of instruction.

Decisions inherent in the evaluation process

The design of program evaluation is dependent upon several decisions which the evaluator must make. First of all, evaluation procedures are dependent upon the kinds of inforamtion needed by the program decision-makers. Some information is decision-oriented. This decision-oriented information is parochial in nature, refers back to the specificity of a particular program, does not demand generalizability, is often needed quickly and must be gathered in a short-period of time from a quick survey or tally. The decision-oriented information often refers to operations analysis or resource allocation. A second kind of information demanded in evaluation is conclusion-oriented. The conclusion-oriented information demands generalizability, relates the program to the external world, is gathered under research-type controls, and often concerns program processes and products. The conclusion-oriented information requires rigor in data gathering and analysis, should be planned in the design of the program, and is often the basis for the judgment of the worthiness of the program.

A second decision inherent in the evaluation process is related to the nature of the variables being measured. Some variables are more difficult to measure than are others. If the variables are internal in the subjects, are in the affective domain, require a degree of transfer to be seen, must be inferred, or are instable; several dimensions of measurement should be evoked. Without a multi-dimensional measurement scheme with these difficult variables, the credibility of the evaluation results is subject to question. As the nature of the variables approach the continuum of variables that can be more precisely defined and measured, the need for multi-dimensional measurement decreases. When the variables refer to fundamental skills, univariate measurement becomes more reasonable and there is less concern with the credibility of the results.

A third decision that the evaluator must make is in terms of size, scope and intensity of the evaluation. As the number of subjects increase, the manageability of the enterprise increase, but the model for analysis becomes more effective. With large samples, the probability basis for decision-making is improved but the flexibility of measurement is decreased. As a sample size decreases, there exists threats of lack of representativeness, decreases in reliability but also increased options in measurement. As the scope of the evaluation is enlarged, the intensity and the specificity of the evaluation is decreased by the logistics problem alone.

A fourth decision which is faced by the evaluator relates to the audience. Differences in personnel seek different kinds of information from an evaluation. Information besides that sought by the reader must be stated in such a manner that confusion and misinterpretation do not occur, since the nature of evaluation data often established basis for improper interpretation. In the design of an evaluation the evaluator must be sensitive to each audience that will utilize the evaluation and develop the data needed by each audience source.

Concluding Remarks

An evaluation process in the educational setting introduces conditions for the adoption of scientific methodology. Evaluation in education should be an on-going process. The purpose of an evaluation system is to feed back information on all relevant aspects of the educational process on a continuous basis. This information feedback is a basis for directed change in education. Evaluation and the information feedback system provide a climate that facilitates quality control in education.

CHAPTER TWO

THE MASSACHUSETTS INFORMATION FEEDBACK SYSTEM:

A Four Phase Approach

William G. Conroy, Jr.

Massachusetts Department of Education

Rationale

In the design of the Massachusetts Information Feedback System, consideration was made of both the positive and negative aspects implied by state-wide evaluation. The design emphasizes development of a comparable state-wide data pool, use of the Research Coordinating Unit as a technical support component to process and analyze the data, scheduled dissemination of feedback, and programmatic research into instructional efforts to meet state-wide and local needs. These activities must be carried on while the system maintains local autonomy in administrative decision-making, in curriculum design, and in school organization.

In order to be effective, state-wide evaluation must be a partnership endeavor, allowing the state to fulfill the tasks which it can do most effectively, namely curriculum design and program modification. Evaluation results can be best used when the information basis is broad, compatible, and impartial, and when the results are anticipated, respected, and utilized in instructional decisions. Hence, data controlled by an agency external to the local school and based upon state-wide referents should provide a dependable basis for decisions. Modification resulting from this data, however, will only occur if and when it is desired, and its need realized in the local school.

Several unusual logistics problems are generated in the collection and by the control of state-wide information within a system which seeks to preserve local autonomy in curriculum design. The enormity of the management and development tasks dictate gradual implementation which include feasibility studies of the processes, evaluation of the total system from a smaller experimental system, training of the personnel in the development of objectives, the development of an adequate test battery, the design procedures for data collection, analysis and feedback, dissemination, and the training of personnel to produce the information and to utilize and interpret the results.

The Massachusetts Information Feedback System must then be thought of as an evaluation which seeks program improvement and modification rather than program condemnation. It must serve as an evaluation instrument, providing information on a state-wide basis and yet preserving local autonomy in curriculum design. The system is designed as a partnership endeavor between state agencies and local schools, and is conceived as a developing process.

To date, a four-phase system has been proposed and is being developed. Modification of this original design, however, is constantly under consideration as the system is implemented. The four phases have been designed to include the information essential to program management and instructional modification: namely program evaluation (more specifically product assessment), process-product evaluation, cost-effectiveness evaluation, and over-all evaluation (or impact study). Perhaps, the best method through which the design can be described is through the presentation of brief descriptions of each projected phase.

Phase I

Program Evaluation

This phase of the evaluation system will provide annual pre-test, post-test, and regressed gain scores for major objectives in every vocational or technical program in Massachusetts.* In each case, objectives will be determined by the local school for each vocational or technical program and tests designed to measure these objectives will be administered by the local schools, and analyzed by the Research Coordinating Unit on a pre-test, post-test basis. Program evaluation will provide both local and state means, standard deviations and estimated gain scores for grades 9-14. Information on attrition rates will also be included.

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* See pages 46-47 for description of a regressed gain score.

Phase II

Process-Product Evaluation

This phase of the evaluation would be conducted through a state-wide survey and through experimental study of a representative sample. Analyses will be performed to determine relationships between specific program variables and student success or non-success in career growth. This phase of the evaluation would consider students who are employed in fields for which they have been trained, students who are employed in fields unrelated to their training, and students who are unemployed. Examples of process variables might be: intensity of training experience, school facilities, teacher characteristics, school characteristics, etc. This phase of the evaluation would also examine relationships between degrees of success or non-success on program objectives and success or non-success in career growth. It would also examine relationships among schools offering similar objectives with different instructional processes in terms of regressed gain scores.

Phase III

Cost-Effectiveness Evaluation

This phase of the evaluation system also would be conducted on a sampling basis and investigate the relationship between cost and effectiveness of vocational-technical education. This phase of the system would quantify and compare cost and effectiveness of various vocational-technical educational programs. Cost-effectiveness evaluation is a helpful planning tool for allocating resources within vocational-technical education.

Phase IV

Over-all Evaluation of Vocational-Technical Education

This phase of the evaluation system would consider over-all objectives of vocational-technical education and evidences of total program impact on the state level. Data concerning over-all programming, enrollment, and economic impact would be gathered through state-wide surveys. The over-all objectives would be assessed through study of random, representative samples. For example, one over-all objective of vocational-technical education might be: a large percentage of students who complete vocational-technical educational programs should obtain and maintain employment in fields for which they were trained and progress satisfactorily in their career; a smaller percentage should obtain and maintain employment in fields closely related to the area in which they were trained and progress satisfactorily in their fields. When compared with similar students who did not complete vocational-technical programs, students who completed vocational-technical programs should enjoy more job success. This difference should be significant. Other variables that might be considered could be: job satisfaction, citizenship behavior, social behavior, and general knowledge.

CHAPTER THREE

PHASE I: PROGRAM EVALUATION

Ray A. Johnson

Jim C. Fortune

University of Massachusetts

Rationale

The program evaluation has been designed to provide feedback on the effectiveness of specific programs in achieving locally entertained objectives. Two essential components of the product assessment, the development of a file of behavorial objectives for each program and the development of a test file for each objective, constitute the major aspects of the program evaluation. Each of these components will be described and procedures for operation will be reviewed in the following sections of the guide.

A. WRITING BEHAVORIAL OBJECTIVES*

The purpose of this section is to bring about a common understanding of the development of behavorial objectives. With this goal in mind, it is only fitting that the author communicate his objectives, so that the reader is able to measure the change in behavior resulting from reading this section.

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*This section of the chapter is a straight-forward, pedagogical exposition of behavorial objectives and is the same material used with instructors in Massachusetts. It was determined that inclusion of this section, in its entirety, would precisely define behavorial objective as we perceive them within the Massachusetts Information Feedback System. (Ed.)

1. Given a list of one to twenty objectives, one identifies, with 100% accuracy, those objectives which are behavioral and those which are not.
2. When presented with a person whose area of vocational speciality is different from that of the reader, one develops behavioral objectives representing that person's field by questioning him about the pertinent information in his area of specialization.

Now that two examples of behavioral objectives have been presented, do they fit the following definition? BEHAVIORAL OBJECTIVES TELL WHAT IT IS THAT ONE WILL HAVE TO DO WHEN HE IS EVALUATED, THE CONDITIONS UNDER WHICH HE WILL HAVE TO PERFORM, AND THE LEVEL OR QUALITY OF PERFORMANCE EXPECTED.

The objectives of a course should contain as many statements, items, or examples as are necessary to describe the desired behavior of the student when he completes the course. Objectives of a course may be written in any form necessary which clearly states the instructional intent of the course.

This might represent an objective, "The student must understand the operation of a milling machine", but the instructions still would have to go on to explain what is meant by "understand" by describing what the student will be expected to do to demonstrate the definition of "understand". Therefore, the objective, as stated, would not provide the necessary information as to what the student would be doing to demonstrate his achievements of the instructional intent.

The purpose of a behavioral objective in the context of this article is to make clear to teachers, students, and other interested persons what a person is expected to be able to do or perform when he finishes a course or program.

A well-written behavioral objective should say three things: It should say what it is that a student who has mastered the objective will do. It should say under what conditions the student will do this. It should say to what extent the student will do this. To put the matter in a single sentence, a well-written behavioral objective should specify under what conditions and to what extent a certain kind of student performance can be expected to take place.

Performance-conditions-extent. Let us consider, first, the word performance. Performance means doing. A student who performs something does something.

Here are two statements. Which one is expressed in terms of student performance?

A. The student has a good understanding of electrical current.

B. The student measures electrical current.

Statement B tells what it is that the student will do. He will measure electrical current.

Statement A tells us that the student will have a good understanding of electrical current. But this is not very clear.

We cannot tell what the student is supposed to be able to do as a result of this understanding. The difficulty with using such verbs as understanding, appreciate, know, is that the performance is not directly observable. We have said that statement B is expressed in terms of student performance. Does this statement also set forth the conditions under which the performance is to take place?

No, it does not. For one thing, we cannot tell from our statement whether the student is to measure the current of an automobile, a house, a hi-fi amplifier, or a flashlight. Also, we do not know how he is to measure it; through mathematical computations, through the use of a meter, etc. Obviously, each set of conditions that one might develop is substantially different from the rest, and will make its own special demands upon the student who attempts to accomplish the objective.

Let us examine two more statements. Which one sets forth the conditions under which a certain kind of performance is to take place?

A. Given a circuit to operate a light bulb, the student indicates how to measure current with an ammeter.

B. The student will measure current at least 90% of the time when presented with electrical devices.

Statement A tells us that a circuit containing a light bulb, and an ammeter will be used to set the conditions for the demonstration of the student mastery.

Statement B offering us only the dubious clue of "electrical devices", does not tell us enough. Our conditions need to be defined more precisely than this. Therefore, statement A would be the correct objective.

We come now to the matter of the extent and level of performance. A well-written instructional objective establishes acceptable minimum standards of achievement.

Look at Objective A: Given a detailed drawing containing five cutting operations, the student performs them on a wood lathe.

This objective is behavioral in that it states the desired performance that the student must exhibit and under what conditions, but it does not include an evaluative measure that would tell both the student and the teacher what is acceptable performance.

The objective should communicate how well the student performs when he has mastered the objective. Possibly, the most obvious way to indicate to what extent a student performs is to set a time limit. This criterion is easy to measure, but it does not always apply.

"The student disassembles a two-barrel carburetor in fifteen minutes." The statement "in fifteen minutes" leaves no doubt as to the extent of time the student has to perform the task. In some cases the time extent might be of little concern. The fact that the student can "disassemble a two-barrel carburetor" is fact enough to the accomplishment of a desired performance.

Whenever a minimal level of acceptance is desired, there should be an indicator that communicates to what extent the student should perform. The following are some examples that might provide some various ways of stating a criterion of acceptable performance.

Minimal Number

"When shown ten slides representing the Silver Culture of the N.E. Region of the U.S., the student matches the proper method of water and lumber management with at least nine slides."

Percentage

"Given the grass seeds that are indigenous to the N.E. Region of the U.S., the student categorizes them into the varieties of bent grass, blue grass, fescue, and rye with 90% accuracy."

Tolerance of Deviation

"On an engine lathe the student turns NC Thread #24 with the American Standard Association Class #2 fit."

In some instances his ability to perform a job with a certain degree of accuracy is pre-determined by the minimal acceptable requirements within a job area. In electricity, for example, the requirements are regulated by the National Electrical Code.

A minimal acceptable performance could relate to either an individual, an institution or a prerequisite requirement for job entry. Referring back to Objective A, it might read: Given a detailed drawing containing five cutting operations on an engine lathe, the student performs them within one-sixteenth of the specification set forth.

What should be included in a clear definition of an educational objective? Sometimes there is confusion about clarity and specificity. An instructor could end up with several hundred objectives for one division within a course which is probably too specific. Alternately, the existence of only a few, general objectives lacks clarity and fails to communicate enough specifics about the course to enable measurement. Let us not be confused with specifying the various teaching procedures or learning activities as instructional objectives; they are not objectives. The objectives should be stated at the level of behavior the instructor intends for the student to acquire. For example, a generalized behavior might be the ability to de-horn a calf. The objective then could be stated as: Given a caustic compound, the student de-horns a seven to fourteen day old calf without burning the calf's skin or having the horns grow back.

The emphasis is on the behavior to be learned by the student rather than how the student acquired the ability to perform the skills. As one can readily see, there are many skills to be learned and a variety of knowledge that one must accumulate to meet the objectives. However, the objective does not specify or limit how one is to go about acquiring the knowledge or skill. The issue is only how the terminal behavior will demonstrate proficiency in internalizing the skills and knowledge. Specifying the kind of behavior to be developed and the kinds of content involved is necessary to guide the selection of learning experiences and to evaluate results. However, this specification should avoid a degree of documentation which leaves no alternatives for adaptive instruction.

A statement of a behavioral objective enables evaluation to be based on a student's performance and not on an unknown element of appreciation, comprehension, or understanding. This behavior which the student exhibits may be anything from a manipulative demonstration skill to writing an explanation of that skill.

After one knows what the necessary ingredients are in a behavioral objective, he needs a systematic way to go about arriving at the objectives. [During this pilot year and because of the experimental nature of the information feedback system, the Research Coordinating Unit is asking for a representative sample of objectives.] An instructor may take the already existing "K" blanks* and/or courses of study and state the basic divisions which are the most meaningful and cumulative of his instruction.

*"K" blank is a Massachusetts Task Analysis Form.

To increase communication, the following definitions have been accepted.

Course--the Vocation in which a student is enrolled (Automechanic-Horticulture)

Division--a field within a Vocation (Fuel system- Turf Management)

Unit--a task or breakdown within a division (Carburetion-Seeding)

This example of a conceptual matrix is suggested as an aid to help lay out a specific vocational field so that one might develop objectives at the proper level.

Grade Level or Level of Difficulty	Divisions I	II	III	IV	V	etc.
9	5	5	5	5	5	
10	5	5	5	5	5	
11	5	5	5	5	5	
12	5	5	5	5	5	
Total	20	20	20	20	20	= 100 objectives

(develop objectives at each level in each division)

When a division of a course gives a person saleable skills, that division should be broken into behavioral objectives at the Unit Level. For example:

Turf Management is a division of Horticulture, but it is complete within itself. Therefore, the objectives would be developed at the Unit Levels of seeding-equipment, etc. The

Matrix would look like this.

	Unit Levels			
Grade Level	Seeding	Equipment	Budget	etc.
9	x	x	x	
10	x	x	x	
11	1,2,3,4,5	1,2,3,4	1,2	
12	x	x	x	

The objectives will be compiled and recorded on a form so that necessary and pertinent information about the objective can also be stated. For instance, an instructor desires a particular kind of testing procedure to be used, or knows of an instrument already in existence, it would be helpful to state that fact. Here is an example of the objective worksheet which is to be used this year.

OBJECTIVE WORKSHEET

School	Marshall High	Course	Electronics
Grade or Level	10th grade first level	Division	Circuitry
Instructor	Roger Tunks	Unit	Resistance

The following objective is stated in terms of observable student performance:

(Performance-Conditions-Extent)

1. Given five carbon resistors, a student will read the colorband and compute the resistance of four

out of five resistors with 100% accuracy.

Suggestion

*Type of Test Desired: Randomly select five 1/4 watt carbon

*Type of Test Available:

Other Pertinent Information:

B. TESTING

Introduction

Since the evaluation and information feedback system depends upon content designation by each individual school, it is conceivable that each school would desire and develop different behavioral objectives within each curriculum division. Although this possibility exists, totally different objectives for each curriculum division do not seem probable; however, a variety of objectives within each division must be anticipated in the design of the testing process. The anticipation of unique objectives and the variety of conditions existing in the sample schools demand flexibility and continuous development of the testing process. These conditions include different lengths of both classes and school days, different administrative structures, varied course sequences and organization, varied sources of related courses and different resources, such as staffing patterns, student composition and equipment. In order to establish flexibility several formats of assessment will be utilized. To assure continuous improvement of instrumentation a test development staff will be located in the research coordinating unit to identify and collect available instruments. These include licensing tests, standardized tests, and certification examinations currently being utilized in the field. This will aid in developing tests specifically designed to assess unique program objectives. This section will deal with both the anticipated development of the testing process and the planned analysis of the test data.

Format of Testing

Basically, the information feedback system will rely on a pre-test, post-test format of testing, except when pre-testing may be deemed inappropriate due to time consumption or exceptional risks. The pre-test, post-test format consists of criterion testing prior to the beginning of the instruction in a curriculum unit and post-testing with the same instrument after the instructional unit has been presented.

Since instructional units vary in duration and differ in the time of the school year in which they begin, the development of a manageable testing schedule is paramount in importance. The chronological schedule of testing will utilize the enrollment point immediately prior to the beginning of instruction and then will be post-tested at the end of that program level, such that the pre-test, post-test cycle will include the total program level or a yearly increment of instruction depending upon which is the shortest.

It is anticipated that the objectives of several units will be included in each program level and will be tested at the same or approximately the same time. Hence, during the first one or two days that a student attends classes for the program level in which he is enrolled, he will be pre-tested on the behavioral objectives for that program level. The same amount of time will be required for post-testing at the end of the program level. A maximum of two days of testing will be utilized for any program level.

Due to the nature of the objectives being developed and due to the nature of the curriculum, the pre-testing, post-testing format on stated criteria will probably be inappropriate in many cases. These cases will generally evolve when the behavioral objectives demand time-consuming criterion tests involving student performances or when neophytes must be subjected to expensive or dangerous machinery in order to be pre-tested. Both of these situations tend to require performances which can be simulated for pre-testing. Hence, a simulation test designed to provide entry diagnosis of fundamental skills or knowledge will be used instead of the criterion-centered pre-test.

Two variations of testing are conceivable within the simulated pre-test, criterion-centered post-test format. In the first variation, the simulation test will contain enough fidelity to the post-test, that the post-test performance will demonstrate criterion attainment from a baseline defined by the simulation pre-test. Hence, criterion attainment becomes the evidence of gain and degree of such attainment constitutes the instructional product.

In the second variation, the simulation pre-test would not be interpreted as representative of adequate baseline information, since an assumption could be made that criterion performance may be influenced but not depend totally on successful performance on the simulation tests. Two types of post-testing become essential; both the criterion-related post-test and the simulation test would be given at the end of the program level. Corrected gain scores on the simulation test would be used to ascertain change and the criterion-related post-test would demonstrate the accomplishment of the objective. Using the criterion-related test, progress would be shown through the post-test format only, since entry into the course assumes a zero beginning point. (In this case, success on simulated pre-tests would indicate the need to either allow the student to be pre-tested on the criterion-related test or to pursue a more advanced objective.) In retesting with a simulated test, changes in prerequisite behavior of the student could be shown.

In both formats the basic objective is to estimate the results of instruction designed to develop a specific objective. Although the formats tend to produce different kinds of evidence of instructional results, the evidence produced can be used in the same manner in the decision-making required to improve and modify instructional techniques.

Test Administration

The three facilitators at each sample school will be asked to coordinate the testing formats.* The specifics of test administration will be expected to vary among the schools; however, the testing formats will be held constant. Testing schedules for each program level will be developed for each school and coordinated between schools so that comparable instructional units of time are maintained. Both the pre-tests and post-tests will be administered according to the administration instructions included with each test at each school and the completed tests will be sent to the Research Coordinating Unit for analysis.

Test Development

One of the major activities of the Research Coordinating Unit is the development of a test battery for measurement of the behavioral objectives. This test battery will be composed of a collection of existing tests and licensing examinations which appropriately meet the testing requirements of the system, the development of tests in areas where no suitable tests can be found, and the specification and standardization of rating procedures for performance tests. After a coding system has been utilized to categorize the objectives, a similar cross indexed file of measuring instruments will be set up. This file will contain the testing instruments and a historical profile on each test.

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* Applies to pilot study only.

A brief discussion of the information which the historical profile will contain is in order. The profile will provide four kinds of information about the test, namely; (1) information on proper usage of the test including the objectives for which the test is appropriate, when and with what testing format the test should be used, and a record of test usage; (2) information upon the effectiveness of the test including reliability and validity evidence; (3) information upon how the test should be administered so as to assure comparability of testing conditions; and (4) information upon the measurement procedure used by the test so that proper methods of data analysis can be utilized.

The information on proper usage of the test will include a list of objectives for which the test has been designed, the curriculum division and level for which the objectives were written, the testing format within which the test should be used, the source of the test, and a record of who, when, and where the test has been used.

The information upon the effectiveness of the test will include several kinds of evidence upon reliability and validity, some of which is essential for the computation of estimated gain scores and some of which is needed for proper interpretation of the results. Reliability refers to the consistency of test performance during repeated measures. A test can be said to be realiable when very similar results are obtained for repeated applications of the test. Three types of reliability will be collected for each test. Test, retest reliability (the consistency of the test results for two administrations of the same test to the same group of students) is essential for the computation of estimated gain scores and will be studied for each instrument. Split-half reliability (the degree of consistency of measurement between the odd-items and the even-items of a test) and parallel-form reliability (the degree of consistency of measurement between comparable forms of a test) will be reported also.

Validity is the criterion for adequacy of a test which deals with the degree to which a test measures what it has been intended to measure. Evidence of three forms of validity will eventually be developed on each test. The first form of validity that is relevant is content validity which requires judgment concerning how well the test samples the behavior which it is supposed to test. Evidence of concurrent validity (how well the test corresponds or correlates with a second criterion measure taken at the same time) and evidence of predictive validity (how well the test corresponds to or correlates with a future criterion measure) will also be developed and included in the profile.

Information upon how the test should be administered will include the time required for proper administration of the test, the supplies and equipment needed to administer the test, the setting required for testing, the directions which must be given to properly administer the test, and the forms upon which test data is to be reported.

The information upon the measurement procedure used by the test is necessary to determine proper statistical treatment of the data. Four forms of measurement are used in testing and each form places demands upon the type of analysis that can be made on the data. In nominal measurement, labels are assigned to objects so that these objects can be placed into categories. No attempt is made to place value or size to the categories. In ordinal measurement, objects are ranked in regard to a characteristic, but there is also an attempt to estimate the difference in the characteristic between ranks through the establishment of intervals which approximate the magnitude of existence of the characteristic. In ratio measurement, both the ranking and the assignment of magnitude by equal intervals which occur in interval measurement are utilized, but an additional refinement of measurement in terms of an "absolute zero" is added where there is no evidence of the characteristic measured.

Analysis and Reporting of Test Results

Generally, the evaluation feedback system is concerned with a descriptive comparison of specific class distributions to the parallel statewide distributions on a common objective. The feedback report form will provide the statistics for these basic comparisons, but the comparison and analysis of its meaning must be made by the local educator who has the most complete knowledge through which decisions can be made. The report form will include the means, the standard deviations, the number of scores analyzed, and the estimated gain scores on an objective for the class and for every other class entertaining that objective.

For the clarity of interpretation of the data, the meaning of the statistics reported back should be explored. First of all, it should be noted that the number attempting the objective and the number satisfactorily completing the objective is in itself meaningful and usable data. Differences from the number entered and the number finished for a program and for the entire state provides a basis through which attrition rates can be compared.

Also, reported in the form is the mean and standard deviation on both the class and the state. These two statistics serve to describe the distributions of the two sets of scores. The mean (mean equals sum of scores divided by the number of scores) used is the arithmetic average of the scores made by the group. The means serve as measures of central tendency and describe the performance level of the class and of the state as a whole. The standard deviation indicates how the class scores were spread around the mean. Hence, by use of the mean and standard deviation, the report presents a visual picture on what the average performance was and how members of the class performed in regard to that mean. By showing both average performance and distribution of scores around this performance for both state and local programs on a pre-test post-test basis, change of the local group can be compared to change of the state group. The standard deviation can be thought of as the average distance of the individual class scores from the mean, although a squaring process and then the square root of the summated results is used to get rid of the sign problems created by the existence of subjects falling on both sides of the mean. Hence, the standard deviation represents the average distance of the scores from the means, but it is calculated by taking the square root of the mean-squared deviation from the mean.

The gain scores that will be reported have been called "adjusted" or "estimated" gain scores since a statistical correction has been made to account for chance variation and to remove the difficulty of unequal rates of change for extremely high and extremely low scores. The correction will be achieved by using the Lord model (See in C.W. Harris-Problems in Measuring Change, University of Wisconsin Press, 1967.) predicting gain by regression of the pre-tests on the post-test. The Lord formula states that $\hat{G}$ (which is individual student gain) equals $\overline{G}$ (which is the difference of pre-test and post-test means) plus b_{Gxy} (where b_{Gxy} is the partial regression coefficient defined by the formula

$$b_{Gxy} = \frac{(1-r_{yy'})r_{xy}s_y/s_x - r_{xx'} + r^2_{xy}}{1-r^2_{xy}}$$

where $r_{yy'}$ is test, re-test reliability on the post-test measure, r_{xy} is the correlation between pre-test and post-test scores, s_y and s_x are standard deviations of x and y, and $r_{xx'}$ is the test, re-test reliability for the pre-test) times the deviation of x from the mean $\overline{x}$ minus b_{Gxy}

(where $$b_{Gxy} = \frac{r_{yy'} - r^2_{xy} - (1-r_{xx'})s_x r_{xy}/s_y}{1-r^2_{xy}}$$

from the mean of the post-test. Hence, an estimated gain for each student can be computed and an average of these is the reported gain score. This estimated gain score would then lead to comparisons between the class and the state on a group level. Upon request, however, gain scores for individual students can be obtained for more specific analysis of instruction.

CHAPTER FOUR

PHASE II: PROCESS-PRODUCT EVALUATION

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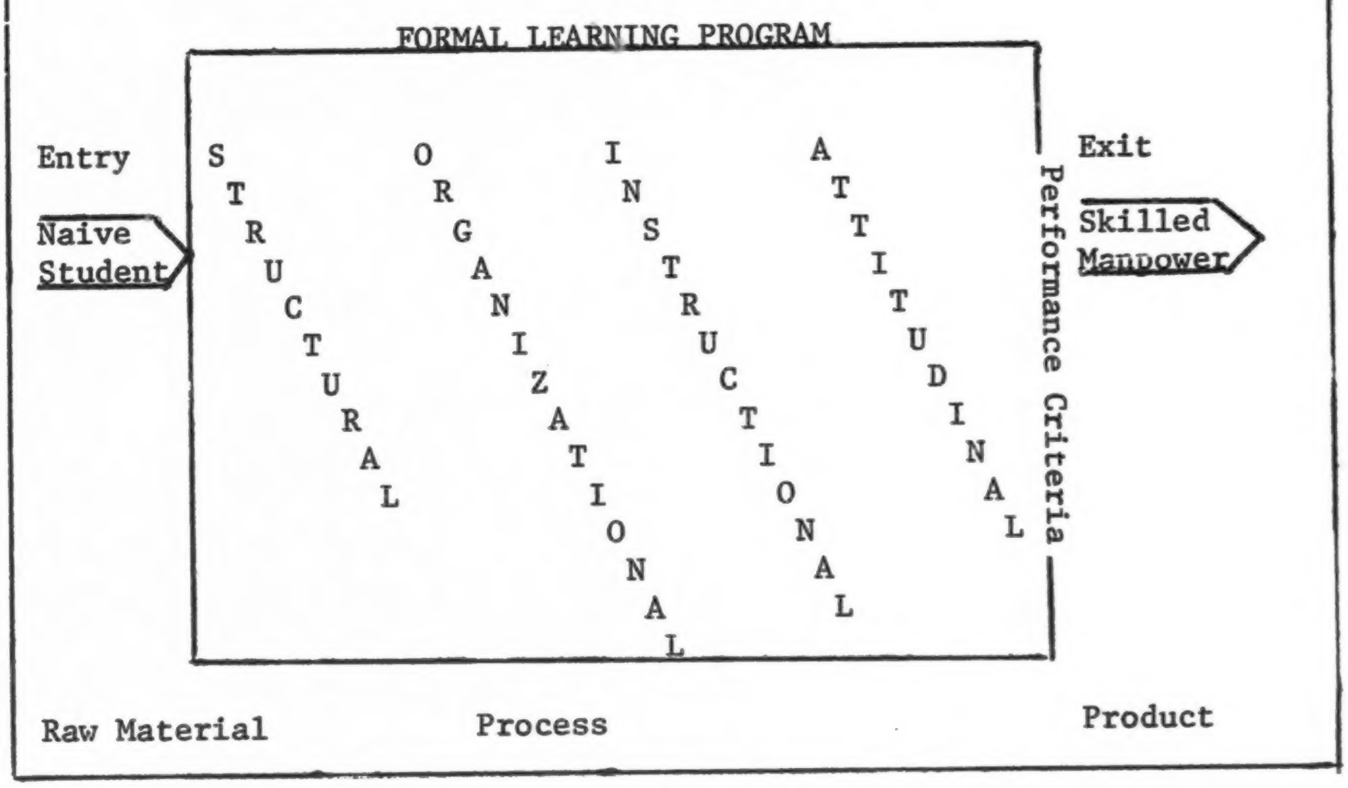
Overview

When the process dimension in evaluation is discussed, an attempt is made to specify some distinct and defineable factors that may be separated from the totality of events which impinge upon a student as he goes through a formalized learning program. Only those factors which may have influenced the final product, a skilled student, are to be recorded. One should try to record, in some way, those significant events in the learning program which may have contributed to the quality of the product. A conceptualization can be illustrated in Figure 1.

Figure 1. Flow Diagram of Educational System


FORMAL LEARNING PROGRAM
Entry
Naive Student
STRUCTURAL
ORGANIZATIONAL
INSTRUCTIONAL
ATTITUDINAL
Performance Criteria
Exit
Skilled Manpower
Raw Material
Process
Product

It is possible to conceive of untrained or naive students entering some formal learning program and leaving after 1 day, 6 weeks, or 4 years, as a skilled person in his field, be it music, English, or auto mechanics. While in the program, certain structural considerations might be thought of as having an influence on the quality of the final product which is turned out. That is, the quality of the learner's experience may be effected by such things as the size of the building, the number of units of a certain piece of equipment, etc. These types of variables may be categorized under the heading of structural considerations when developing ideas about important process components. Further discussion of these ideas will appear below.

Just as certain structural considerations define certain opportunities and limitations in learning, so do the organizational developments which occur. Organizational variables which might impinge on the student as he goes through a learning program are size of class and type of degree program (vocational, general, academic). All matters that are related to the way the learning process is organized within certain kinds of structures are included in this category and elaborated on below.

Figure 1 notes also the instructional considerations occurring within certain structural and organizational patterns. Included for consideration in this category are such factors as ability rating of the instructor, preparation of instructional material and degree of individualization of instruction. In short, this category will be used to conceptualize the variables in interpersonal teacher-student contact which may bear on the quality of the product.

Finally, one may conceive of the development of certain attitudes which students develop as a direct result of, or because of interaction with the structure, organization, and instruction to which they are exposed. The attitude toward their school, and towards their schooling in general, would be important information to have. Such things as the student's feelings of competency, and feelings about his job prospects may be considered. Virtually, any attitudes toward school, self, and society might come under study.

The preceding discussion of structure, organization, instruction, and attitudes all may influence performance at stated criterion levels. The evaluation of performance through a statement of behavioral objectives has been discussed earlier in this document. The variables mentioned in this section are variables which may influence that performance level of students and are, therefore, important because of their effect on our product...skilled manpower. A more detailed discussion of each category and the variables to be considered, therein, is provided below.

Structural Considerations

The intent of defining a category called structural considerations is to pick out those aspects of the formalized learning process which are either invarient, or at least hard enough to change so that they appear invarient. Thus, we are distinguishing between the more static aspects of an educational system and the more dynamic aspects. In the latter case, we would be discussing organizational considerations. The organizational aspects of a system are more fluid and subject to change than are the structural aspects, which more nearly represent the "givens" of the situation, thus making this the hardest-to-change aspect of the system.

In considering structural aspects which may effect the product, one might want to note something about the facilities and equipment available, i.e., the resources brought to bear on the learning process. One might ask about the buildings; their size; student capacity; age; and dollar value of the plant. Under this category, information about the available equipment might include:

number of pieces of equipment of a specialized type, i.e., V-8 engines, lathes, and oscilloscopes; dollar value of equipment; age of equipment; etc. One could include, within this category, information on the socio-economic and demographic characteristics with which a school must concern itself, for example: the neighborhood within which the school lies; neighborhoods from which the school draws students; whether the vocational training is occurring within an industrial community, or whether vocational education is occurring within a rural or suburban community. The indebtedness of the district might be questioned; tax rate for schooling; and per pupil expenditures in vocational and academic programs. These could then be used as indices of a district's commitment to educational quality.

The category of structural considerations is intended to aid the reader in conceptualizing those difficult to change, or invarient aspects of an educational system. Disagreement or agreement with the examples is not important. Certainly, no attempt was made to be exhaustive. A set of variables which may influence the product have been illustrated and these variables seemed to group naturally under a heading called structural considerations.

Organizational Considerations

Under the category of organizational considerations in process documentation, those aspects of learning processes, which are fluid and subject to much more change than the variables listed under the structural dimension are examined. For example, one might include among organizational processes the size of classes; the number of periods per day; whether the school is using open lab or closed lab concepts; etc. All the above are conscious decisions about the way a school should be organized and, therefore, subject to change. The totality of these organizational considerations would represent at any one time the belief system of the faculty concerning the best way to organize the learning process. Under the heading of organization, one then can include such things as: number of business advisory groups; size of those groups; time spent in meetings per month; and all other aspects of the advisory function which may have a direct bearing on the courses taught in a vocational program and the skills to be mastered in that program. One might want to include under organizational considerations such things as pupil-teacher ratio; the qualifications of pupils in academic, general, and vocational programs; the number of units or credits necessary for the completion of a course of study; and the number of vocational electives allowed.

The point in specifying an organizational category is to be able to list those aspects of a formal learning process which, through vote or tradition, have led to certain educational practices which may effect the product in which one is interested.

Instructional Considerations

Under this category variables will be documented which are involved in the instructional process and which may in some way effect the degree of proficiency which a student demonstrates on completion of his training. Here, one might wish to consider such things as the qualifications of the instructor; highest degree held; years of schooling; years of practical experience; positions held in industry; in-service programs in education; and professional affiliations. Perhaps, one would want also to record such things as salaries paid to instructors; differences in vocational educator's pay compared to the scales used in the academic areas; and certifications held or required. Support for the instructional process may be recorded under this category and include such things as number of computer terminals; library facilities; audio-visual equipment available; and number of screens. The point, of course, is to pick out those variables which may effect the quality of the product.

In addition to the support for instruction and background of the instructors, it might well be important to employ measures which tap the interpersonal dimension in teaching. Is the teacher warm, friendly, clear in explanation, well-prepared, and fair? The characteristics of an instructor or the "climate" created by an instructional staff can certainly be expected to impinge on the student as he goes through an educational system.

Attitudinal Considerations

Given a certain structure and organization for an educational system within which a certain kind of instruction takes place, student attitudes of varying degrees can be expected to develop on many divergent topics. To tap such information would aid in the overall program design to obtain data which leads to modification as well as evaluation. Thus, under this category one might consider important the student's feeling of personal worth; does the self-image of the student reflect confidence and pride? what attitudes exist toward certain courses? toward instructors? toward school in general? toward their school in particular? Information about reality testing by the student such as his feelings about the pay he is likely to receive; attitudes toward unions; toward job stability and mobility; toward his own prospects to obtain employment might be documented.

Since people hold opinions, attitudes and beliefs about myriad events, some decisions about which of these are important must be made. These decisions, as with all other decisions about which variables to examine, must be made on the basis of known or hypothesized effects on the quality of the final product of the system. Described below are methods for obtaining information about process variables deemed important in evaluating an education system.

Procedures

The goal of process-product evaluation is the detection of relationships between what the student experiences and what his skills are. Thus far product has been discussed as if it were uniform, but in fact there exists excellent, fair and poor products in an educational system. There are products who become regularly employed, irregularly employed, and unemployed. There are products who are employed in capacities that use the skills in which they were trained and others who are employed in areas for which they were untrained. These particular type of outcome variables, the product dimensions, may be related to certain antecedent conditions such as the structure, organization, instruction, or attitudes involved in the educational process.

There are many ways to record process information which may be useful in determining some relationships with outcome measures. One of these is the process log.

A process log is a continuing record of important events which may be related to performance. It is recorded by an instructor shortly after some instruction has taken place. The log might be broken up into records of the teaching that has occurred for each statement of performance criteria which had been set. Thus, if the performance criteria was an adjustment of a two barrelled carburetor to the required idling speed for a specific engine model, a teacher might record as an entry in the process log information about how the material was taught, as shown in Table 1.

Table 1. Process Log Example

Date	Performance Criterion	Log Entry
3/24/70	#821 Carburetor Adjustment to idling speed.	Carburetor adjustment taught by lecture, no laboratory practice until one week after lecture. No model used for demonstration. Diagram with labelled parts was used during lecture. Lecture took 50 minutes.

This kind of entry--especially when evaluated against teaching techniques which either included a demonstration of an actual carburetor adjustment, or which placed unadjusted carburetors in front of each student to adjust as the instructor worked, or which used magnification shots over closed circuit television to show the procedures, etc.--then becomes the documentation of the process used and serves to ferret out for an investigator those procedures that work from those procedures that do not work, insofar as obtaining optimum performance for a stated objective.

Essentially, then, a process log is a documentation of methods used to achieve certain ends. In addition to the uses of the log noted in the illustration shown, a log can be used to record time in laboratory, number of students in the group, fixed equipment costs, amount of equipment available, length of class time, etc. Thus, for the start of a unit on the use of the oscilloscope, the process log could include statements about structure (number of oscilloscopes available, performance level of students); statements about organization (class periods of 50 minutes, 27 students all seniors); statements about instruction (I hold a Navy electronics technicians certificate, no movies available, I feel good teaching this material and am well-prepared); and statements about attitudes (students seem eager to learn this, only a small number are showing interest, few smiles are evident, etc.). The log then would provide the instructor's view of the learning process: what he did, what he used, what he noticed, and with whom he worked are all data to be recorded and preserved, for later distillation and examination.

Other ways to document process variables exist. For some variables of interest other techniques would make for better documentation. These techniques include rating scales and check lists. The simple rating scale makes the person doing the rating the measuring instrument. All the scale does is systematize that measurement along a continuum. For example, using the categories described above, we may use the following kinds of rating scales:

Structural

This school building is:

unsatisfactory, a hinderance to learning	poor but serviceable	about average in condition	good, should aid learning	excellent, completely satisfactory

Organizational

Class size for this learning sequence was:

too large, injurious to learning	too large	about right	smaller than need be	small enough for extensive individual attention

Instructional

Class participation:

almost never occurs	occurs with urging	occurs regularly	occurs quite frequently	always occurs

Attitudinal

Students appear to be:

always interested and cooperative	usually interested and cooperative	average in their interest and cooperation	sometimes interested and cooperative	hardly ever interested and cooperative

These kinds of rating scales can be made up for variables of interest and used with individual instructional segments for meeting performance criteria, or for longer units, or for whole curricula. They can be used repetitively, singly, or in the case of some scales even by random schedules in order to monitor the systems under study. The documentation of attitudinal considerations should utilize the students as well as the instructor as the measuring instrument. The students provide valuable feedback from a different and important point of view.

The use of checklists can also play an important part in the documentation of process variables. This simple device allows a respondent one of two responses, agree or disagree (dislike or like) as evidenced by either a check mark or a lack of a check mark given to a particular statement. Some examples follow:

Check those items with which you agree:

______1. Our facilities are adequate.

______2. There is too much moving around during the school day.

______3. Teacher-student relations are pretty good at this school.

______4. Students are not well-prepared for employment when they leave here.

The above example includes a checklist item from each of the categories previously described. Hundreds of checklist items could be developed and the instructor and/or the students could fill out such lists.

The documentation of process variables by way of rating scales will allow an analyst to average the scale's scores (provided equal appearing intervals were used) and meaningful pre-post comparisons could then be made. In the case of the checklist, information would be tabulated in precent of respondents who agree with an item. Changes over time in percentages may also be evaluated statistically for significance if relevant program changes have taken place between the two administrations of the checklists.

Still another, and perhaps, the most popular form of documenting process information is through the use of standard questionaire items. Information about variables in each of the categories noted might be obtained through the use of a questionaire which provides all the background information necessary to interpret, in a more meaningful way, many of the entries in a process log. That is, to know that an objective concerned about welding was taught by film is useful. To know also that the student body at a school is primarily from families receiving welfare would make our information base about the learning associated with the film that much greater. Extensive questionaire development might accomplish that task. Some examples of questions used by the U.S. Office of Education to examine process are provided. Some item formats are like the rating scale and checklists.

Examples of questions most easily answered by district personnel might include:

A. Which of the following best describes the location of this school district?

( ) a. Large city (over 500,000)
( ) b. Suburb of a large city
( ) c. Rural area near a large city
( ) d. Middle-size city (50,000-500,000)
( ) e. Suburb of a middle-size city
( ) f. Rural area near middle-size city
( ) g. Small city or town (less than 50,000)
( ) h. Rural area, not near a large or middle-size city

B. Indicate the current starting annual salary in your school district for a beginning credentialed high school teacher with a bachelor's degree. $_________.

C. Which of the following types of personnel in your district have participated in in-service training programs since June, 1968? (Mark the percent of that group who participated.)

( ) a. Regular classroom teachers
( ) b. Special teachers (e.g. remedial reading teachers)
( ) c. Teacher aides
( ) d. Other professional personnel (e.g. health or guidance personnel)
( ) e. School principals

Other questions most easily answered by a principal at a particular school include:

A. Grades in this school are
( ) K-6 ( ) K-12 ( ) 10-12
( ) 1-6 ( ) 1-12 ( ) 7-8
( ) K-8 ( ) 7-9 ( ) Other (list) ______
( ) 1-8 ( ) 9-12

B. ADA for January was ______________(total for all grades)

C. The number of new enrollees last year was ______.

D. The number of transfers or withdrawals last year was ___.

E. How old is the main classroom building of your school plant?

( ) a. Less than 1 year old
( ) b. 1-4 years old
( ) c. 5-9 years old
( ) d. 10-19 years old
( ) e. 20-29 years old
( ) f. 30-39 years old
( ) g. 40 years or older

F. Indicate in FULL-TIME EQUIVALENTS the number of the following types of professional staff members available to pupils in your school:

a. Regular Classroom Teachers (academic subjects)_____.
b. Regular Classroom Teachers (vocational subjects)_____.
c. Special Instructional Personnel (speech, physical education, art, music, reading, etc.)_____.
d. Health Personnel (school nurse, school physician, etc.)_____.
e. Psychological Personnel (social workers, counselors, school psychologist)_____.
f. Media Specialists_____.
g. Paid Community Personnel_____.
h. Volunteer Community Personnel_____.

G. In your opinion, which of the following best describes the dwellings in the immediate area of this pupil's home?

( ) a. Well-kept single family houses
( ) b. Well-kept multi-family dwellings
( ) c. Run-down single family houses
( ) d. Run-down multi-family dwellings
( ) e. Don't know

H. Sometimes there are occasions when special problems such as natural disasters, epidemics, teacher strikes, etc. have long and prolonged effects on instruction.

Have there been any significant acts, affecting your school, such as those listed above?

( ) Yes
( ) No

If yes, how many weeks was instruction interrupted?

( ) One week
( ) Two weeks
( ) Three weeks
( ) Four or more weeks

I. Are students grouped in classes

( ) Heterogenously
( ) Homogenously

J. What percentage of the pupils in this school are members of families whose HEAD OF HOUSEHOLD did not complete the 8th grade?

( ) None ( ) 1-10% ( ) 11-25% ( ) 26-50%
( ) 51-75% ( ) 76-90% ( ) 91-100%

K. What percentage of the pupils in this school are members of families whose primary means of support is a public welfare program?

( ) None ( ) 1-10% ( ) 11-25% ( ) 26-50%
( ) 51-75% ( ) 76-90% ( ) 91-100%

Certain questions are perhaps best filled out by the teacher. Examples of such questions are:

L. What is your sex?
( ) Male ( ) Female

M. How many years of full-time teaching experience (public and non-public) including this year, have you had?

( ) a. One year or less
( ) b. More than 1 year but less than 3 years
( ) c. At least 3 years but less than 6 years
( ) d. At least 6 years but less than 10 years
( ) e. 10 years or more

N. How many years, including this year, have you taught in this school?

( ) a. One year or less
( ) b. More than 1 year but less than 3 years
( ) c. At least 3 years but less than 6 years
( ) d. At least 6 years but less than 10 years
( ) e. 10 years or more

O. Do you reside within the attendance area or neighborhood of this school?

( ) Yes ( ) No

P. Are you a member of one of these NATIONAL MINORITY GROUPS?

( ) a. Yes, American Indian
( ) b. Yes, Negro
( ) c. Yes, Oriental

Yes, Spanish-surnamed American of:
( ) d. Cuban Descent
( ) e. Mexican Descent
( ) f. Puerto Rican Descent
( ) g. Spanish Descent

( ) h. No

Q. Did you choose to teach at this school this year?

( ) a. Yes, from among many alternatives
( ) b. Yes, but the choices were few
( ) c. No, I was assigned here
( ) d. No, there is only one elementary school in this district

R. Would you prefer to be teaching in a different type of school?

( ) a. Prefer a different type of school
( ) b. Prefer another of this type
( ) c. Satisfied here
( ) d. Greatly prefer this school
( ) e. Don't know

S. Estimate the proportion of pupils in your class who come from families in which the head of the household is employed at the following level: (Mark one answer in each line.)

	None	1-10%	11-25%	26-50%	51-75%	76-90%	91-100%
Children of professional or managerial workers	( )	( )	( )	( )	( )	( )	( )
Children of skilled workers	( )	( )	( )	( )	( )	( )	( )
Children of semi-skilled workers	( )	( )	( )	( )	( )	( )	( )
Children of non-skilled workers and laborers	( )	( )	( )	( )	( )	( )	( )
Children of agricultural workers	( )	( )	( )	( )	( )	( )	( )
Children of disadvantaged--welfare or unemployed	( )	( )	( )	( )	( )	( )	( )

T. What proportion of the pupils in your class are members of the following NATIONAL MINORITY GROUPS? (Mark one answer in each line.)

	None	1-10%	11-25%	26-50%	51-75%	76-90%	91-100%
American Indian	☐	☐	☐	☐	☐	☐	☐
Negro	☐	☐	☐	☐	☐	☐	☐
Oriental	☐	☐	☐	☐	☐	☐	☐
Spanish-surnamed American of:							
Cuban Descent	☐	☐	☐	☐	☐	☐	☐
Mexican Descent	☐	☐	☐	☐	☐	☐	☐
Puerto Rican Descent	☐	☐	☐	☐	☐	☐	☐
Spanish Descent	☐	☐	☐	☐	☐	☐	☐

U. According to your own judgment, what proportion of the pupils in your class are generally performing below grade level?

☐ a. None
☐ b. 1-10%
☐ c. 11-25%
☐ d. 26-50%
☐ e. 51-75%
☐ f. 76-90%
☐ g. 91-100%

V. What are the average number of minutes per INSTRUCTIONAL PERIOD, number of classes per week, and number of weeks per year spent in instruction in your class in your subject area?

My area is____________________.

a. Number of minutes per instructional period: (check one)

1. 1-20 ☐
2. 21-30 ☐
3. 31-45 ☐
4. 46-60 ☐
5. 61-75 ☐
6. 76-90 ☐
7. More than 90 ☐

b. Number of classes per week:

1. less than 2 ☐
2. 2 but less than 4 ☐
3. 4 but less than 6 ☐
4. 6 but less than 8 ☐
5. 8 but less than 10 ☐
6. 10 or more ☐

c. Number of weeks per year:

1. 0-6 ( )
2. 7-12 ( )
3. 13-24 ( )
4. 25-30 ( )
5. 31 or more ( )

W. The list below is a list of educational ends or values. There is no right or wrong way to complete this; it is a description of values which a number of educators believe to be important ends of education. Please list your personal preference for those values by marking in Column 1 those values you think are most important, marking in column 2 those values you think are somewhat important, but not most important, and marking in Column 3 those you think are least important. (Mark one answer for each item.)

		1	2	3
a.	Development of obedience	( )	( )	( )
b.	Development of physical and motor skills	( )	( )	( )
c.	Development of respect for the rights of others	( )	( )	( )
d.	Development of good manners	( )	( )	( )
e.	Development of creativity and self-expression	( )	( )	( )
f.	Improvement of one's self-concept	( )	( )	( )
g.	Development of intellectual abilities	( )	( )	( )
h.	Development of personal responsibility for property and materials	( )	( )	( )
i.	Development of vocational interests	( )	( )	( )

Some items which may be appropriate for the pupils themselves to answer or which a teacher could answer about students are:

X. What is the average number of days absent per pupil per month?

( ) 0-1/2 ( ) 1/2-1 ( ) 2-3 ( ) 4-5 ( ) 6 or more

Are these absences primarily due to illness? ( )Yes ( )No

Y. If these pupils are given a difficult task to complete, on their own without prescribed time limits, they usually:

( ) a. Give up without trying
( ) b. Start the problem, but give up rapidly
( ) c. Persist for some time, but do not complete the task
( ) d. Complete the task that was assigned

Z. Items for the student directly:

Who lives with you at your home?

a. Father ( ) Yes ( ) No
b. Mother ( ) Yes ( ) No
c. Grandmother ( ) Yes, one ( ) Yes, both ( ) No
d. Grandfather ( ) Yes, one ( ) Yes, both ( ) No

e. Number of Brothers ( )0 ( )1 ( )2 ( )3 ( )4 ( )5 or more
f. Number of Sisters ( )0 ( )1 ( )2 ( )3 ( )4 ( )5 or more
g. Others ( )0 ( )1 ( )2 ( )3 ( )4 ( )5 or more

Which would make your parents happier to hear?

( ) a. You were doing very well in your school work (e.g. reading)
( ) b. You were behaving very well during school

Which would make your parents unhappier to hear?

( ) a. You were doing very badly in your school work (e.g. reading)
( ) b. You were acting very badly during school

Do you have a job after school? ( ) Yes ( ) No

Summary

Though no attempt was made to break these items up into the categories discussed above and no attempt to exhaust relevant questions was intended, the examples given should serve as a stimulus for a creation of questions (rating scales and checklists) and for preparation to record important data in a process log. All the above material was meant to be illustrative of an approach to documenting the important process variables. Flaws might appear in the examples and the categories which have been provided. Good! One should revise the formats to his own liking and add other relevant important variables to document materials on the process of education. It is wise not to use everything presented by way of illustration in a verbatim manner. Variables should be selected to help educators achieve their goals.

What is important to realize is that improvement of teaching techniques and educational systems will only be possible when it is known which techniques are tried, with whom, in what kind of setting, under what kind of conditions, using what kind of equipment and with what sort of observable

CHAPTER FIVE

PHASE III: COST-EFFECTIVENESS EVALUATION

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Cost benefit and cost effectiveness analyses provide decision makers with financial data which can be used in planning the efficient operation of manufacturing and service systems. The managers of systems must decide how to invest resources to maximize returns. They must consider both short and long range goals. They must evaluate current plans and operations to determine if investments will lead toward the anticipated results. They must also evaluate current operations to insure the effective use of resources. Cost analyses aid managers in these responsibilities.

The professional educator is also expected to make policy and operation decisions which are partially based on financial considerations. Cost analysis is an available tool for their use, but the complexities of educational systems does not permit simple application of these tools.

There are many problems which limit the use of these techniques. The lack of a measure of the quality of the output of the system is the largest. However, before the quality can be measured, the output must be defined. A basic question must be answered. "What is the product (the output) of an educational system?" Cost studies usually tend to ignore this problem.

Product (output) is normally measured as academic achievement or in terms of the economic contributions which an individual is expected to make to society. Are academic achievement and dollars suitable measures of the output of an educational system?

The main purpose of this section of product evaluation is to present a suggested approach to cost analysis which is based on the relationship of institutional objectives with instructional programs and related costs. A basic assumption of the proposed technique is that measurable institutional objectives will specify the desired output of the system.

First, however, is a review of the classical cost benefit analysis of an educational system.

The comparison of cost--the investment of resources--and financial benefits of a system is a cost-benefit analysis. Analyzing the financial benefits of the investment of resources provides data for planning efficient programs. Hence, cost-benefit analyses of educational systems are highly desirable.

There are many interrelated variables which need consideration in a cost-benefit analysis of an educational system. Financial benefits may be divided into four dichotomic classifications: individual-society, measurable-non-measurable, direct-indirect, and positive-negative.

The first classification distinguishes between benefits accountable to the individual, e.g., increased earning power, and benefits of society, e.g., an increased personal income tax base. These two examples are also measurable benefits. A non-measurable benefit (or one difficult to measure) is the effectiveness of the individual as a contributing member to the political and social aspects of the society. Increased income is also an example of a direct measurable return, while the above example of a non-measurable benefit is also an example of an indirect return. The fourth dichotomy, positive-negative, distinguishes between positive returns of the system and negative results of the system. Negative results could be categorized as cost, but if cost is defined as the investment of resources and benefits as the returns, it is appropriate to classify negative results also as "benefits" and not as a cost.

Increased personal income and its effect on society is an example of a positive benefit. A list of examples of negative benefits are associated with the student who becomes a system "push-out" (usually referred to as the "drop-out"). The decrease in potential earning and buying power, the resulting decrease in the income tax base, the potential increase in unemployment, welfare, crime, etc., the list of negative "benefits" associated with the "push-out" seems endless. Other negative "benefits", which are not measurable, result when the educational system hinders, instead of increases, the motivation and creativity of the student and when the system does not provide adequate guidance for students.

Costs of the system may be classified as: individual-society and measurable-non-measurable. The cost of operating the system, e.g., salaries, buildings, supplies, etc., are measurable society cost. The loss of property tax due to the use of space by the system and the interest paid on school bonds are also examples of measurable society cost. Money expended for personal needs, e.g., paper, pencils, books, student fees, etc., are measurable individual cost. An example of non-measurable society cost is the misuse of funds due to poor planning.

The number and the relationships of the variables which need to be considered in a complete classical cost-benefit analysis of an educational system presents an extremely difficult task.

Some of the cost-benefit studies of vocational education are listed in the references. These studies have provided data for planning and evaluating vocational education programs.

Is the classical cost-benefit analysis the only procedure for studying the investment of resources and the resulting benefits? The remainder of this section suggests another method for performing a cost analysis.

Since a strong intuitive case can be presented for the economic desirability of an education, the assumption is made that education is financially beneficial. A further assumption is that the characteristics of educated individuals who efficiently contribute to the society are related to the institutional objectives of the educational system. Therefore, the proposed cost analysis, referred to as Cost-Effectiveness Analysis, seeks to study the relationships between institutional objectives, instructional programs, measures of the achievement of objectives, and the cost of the system. (The parallel costs analysis, which seeks to ascertain and to compare specific economic benefits resulting from two alternative programs offered to the same population will be treated in the impact section of the evaluation. This analysis will require only estimates of benefits to the degree that benefit differences between vocational education and an alternative program catering to the same population of students can be observed, and will be studied as part of the economic impact of vocational-technical education).

Analyses of the relationships between institutional objectives, instructional objectives, measures of the achievement of objectives, and cost could provide evaluators and planners with valuable data. Analyses of this magnitude are uncommon in traditional educational research. The above relationships do not have the attributes required of a two-variable, one-man project. Analyses of the above magnitude are not exceptional in the defense and space industries. Therefore, the adaption and application of the expertise of the system analyst to educational problems should provide the tools necessary to broaden the scope of the traditional researcher. One approach which may lead to the analysis of the relationships of the previously listed variables is presented in this paper.

The variables--institutional objectives, instructional objectives, measures of the achievement of these objectives, and cost--and their relationships define a system. To be more accurate, they define a subsystem of the larger educational system. To study this subsystem several assumptions are necessary.

(1) The school system has defined a set of institutional objectives.

(2) Instructional programs are based on sets of instructional objectives.

(3) Institutional and instructional objectives are stated in measurable terms.

(4) Instruments for measuring the achievement of objectives are available.

(5) Accounting and budget data is systematically maintained by the school system.

Cost is defined as the monetary resources allocated through a budgetary process for the operations of the school system. This definition excludes the cost associated with student time and resources, therefore, cost benefit analysis of the results of this approach to the analysis of the relationships of objectives and costs is limited.

There are basically three plans of operation in systems analysis, i.e., collecting data, categorizing and displaying data, and the analysis of data. If the analyst has determined precisely the analysis to be performed, the data to be collected can be defined and the format for categorizing and displaying the data can be designed. A plan for the order of operation on each of three levels can be designed and implemented. This approach is the traditional method of the educational researcher. However, there are cases where the precise analysis to be performed cannot be specified. A study of the data is needed before well-defined analysis can be initiated. The study is essentially collecting and attempting to categorize and display data. Categorization normally will suggest changes in methods of collection as well as indicate additions and deletions to the information being gathered. Therefore, the level of operation--collection or categorization--is constantly changing. Once the collection/categorization stage has been initially completed, then analysis may be initiated. As analysis of the data progresses, it is highly possible that the format of the data will have to be revised and,in some cases, additional information will have to be collected and categorized. The study, and more precisely, the collection and categorization/display levels, is the approach outlined in this paper for investigating the relationships between instructional objectives, institutional objectives, achievement of objectives, and cost of instructional programs.

The matrix is one of the display formats used in systems analysis. A matrix is a two dimensional array. It is used to display values or characteristics which are associated with the pairing of attributes of the two dimensions. Figure 1 is an example of a matrix used to display cost data. The columns are the traditional activities or functions of a school system. The rows are object areas or "line items" of the system. The common method of recording cost for budget and accounting purposes of a school system uses the activity/object breakdown of cost. The sum of the row, "Salaries", would be the total amount of money either allocated or expended for salaries in the system. The sum of the column, "Administration", would be the total cost

Accounting Matrix

Activities

Objects

	Administration	Supervision	Instruction	Bldg. & Grounds	
Salaries	$120,000				
Life Ins.					
Health Benefits					
Retirement					

Figure 1

of administering the system. The square in row "Health Benefits" and in the column "Administration" would indicate the cost of health benefits provided to administrative personnel.

The number of dimensions of an array may exceed the two of the matrix. Sometimes it is beneficial to present data in a three dimensional array. For example, it is possible to extend the previous array of cost data by adding a dimension of "Instructional Programs". Figure 2 is an illustration of this concept. Cost are related not only to specific activities and objects, but they are also assigned to specific programs. Many school systems have extended their accounting and budgeting systems to include the program level. Hence, administrators have readily available data pertaining to the cost of programs. The advantages for planning and evaluation of instructional programs should be obvious.

The variables being considered in this study may be displayed in the matrix format. The first three matrices suggested for consideration are:

(1) A matrix displaying a relationship between institutional and instructional objectives.

(2) A matrix displaying a relationship between institutional objectives and instructional programs.

(3) A matrix displaying a cost relationship between institutional objectives and instructional programs.

Three Dimensional Cost Display

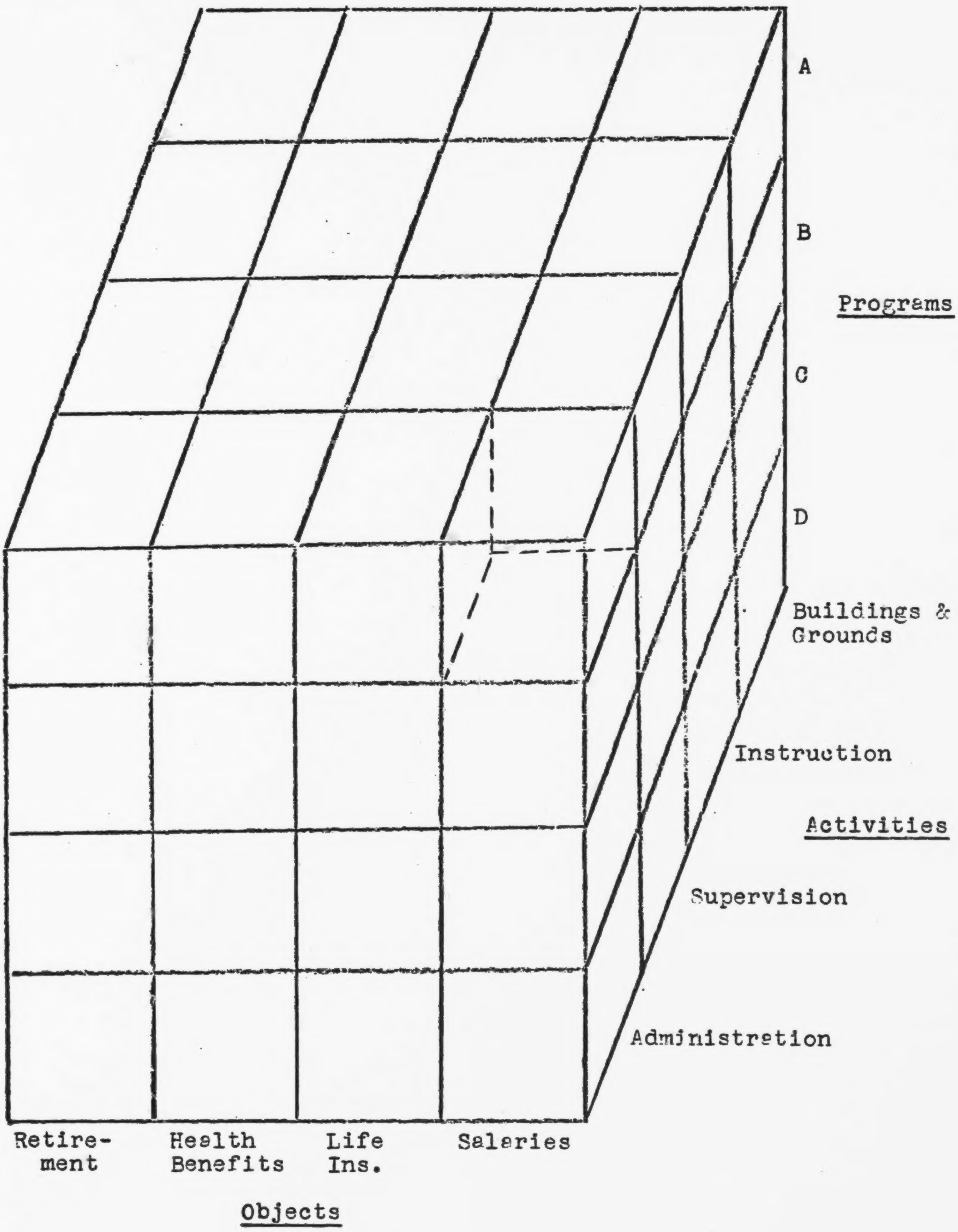
A
B
Programs
C
D
Buildings & Grounds
Instruction
Activities
Supervision
Administration
Retirement
Health Benefits
Life Ins.
Salaries
Objects

Figure 2

Institutional objectives are achieved through instructional programs. Each program is based on a set of instructional objectives; therefore, it is possible to relate instructional and institutional objectives. This relationship is graphically illustrated in Figure 3. Each column of the matrix designates an institutional objective. Rows indicate instructional objectives of a specific program. The squares of the matrix contain one of the following values:

P--The instructional objective was _p_lanned to assist in achieving the institutional objective.

C--The instructional objective will _c_ontribute to the achievement of the institutional objective.

N--The instructional objective will have _n_egligible or _n_eutral effect in achieving the institutional objective.

Figure 1 illustrates a partially completed matrix for Program "A"--a hypothetical instructional program. A similar matrix can be prepared for each of the instructional programs of an institution.

The set of matrices resulting from the above exercise may be combined in a matrix. Figure 4 illustrates a relationship between instructional programs and institutional objectives. The columns are the same as in the previous set of matrices. The rows designate instructional programs. The values of the squares are

Program "A"

Institutional Objectives

Instructional Objectives	a	b	c	d	
1	P	P	C	N	
2	P	P	C	N	
3	P	C	C	N	
4	P	P	C	N	

Figure 3

subjectively determined from the data contained in the first set of matrices. A weight, from 0 to 10, is assigned to each block. If a column of a matrix describing the relationships between instructional objectives contains all P's, then a value of 10 would be appropriate. If a column contains all C's, a 4 may be appropriate. If a column contains all N's, a 0 would be appropriate. Using these three states as guides, values for each square can subjectively be determined. The weights assigned in the first row of Figure 4 are based on the data contained in Figure 3. Weights defined in the above manner are subjective. They are also relative to each other if the same subjective resoning is used in determining all weights displayed in the matrix. Care should be employed in interpreting the data presented in this matrix.

Cost factors can now be added to the display of data. The columns and rows of the next matrix, Figure 5, remain the same, but the values of the squares are determined from the cost assigned to instructional programs. The total cost of a program is proportioned over the institutional objectives according the the weights assigned in the previous matrix. This is accomplished by adding the weights of a row and dividing that sum into the total cost of the program. The resulting amount is then multiplied by each weight to determine the values to be assigned to the squares of the cost matrix. The sum of each row should equal the total cost of a program. For example, if the instructional objectives of Program "A" were only

Weight Matrix

Institutional Objectives

Programs

	a	b	c	d	
1	10	8	4	0	
2					
3					
4					

Figure 4

related to the institutional objectives for which data was presented in Figures 3 and 4, and if the total resources allocated for the program were $12,100, then the cost would be distributed as illustrated in Figure 5. To complete the cost matrix, sum each column. These sums are subjective indications of the budget resources allocated to the achievement of institutional objectives.

The next matrix proposed contains more data than the first three illustrations. One of the assumptions stated earlier was the presence of a measuring instrument to determine achievement of both instructional and institutional objectives. This matrix will present data pertaining to the success of students in meeting the stated objectives. Success is defined as a state where a student has either demonstrated he has reached a specified level of performance or that he has achieved a specified incremental increase in his level of performance on a specific objective. From this data the percentage of successful students of a given population can be determined. Several sets of percentage data can be derived. These are displayed in the following matrix, Figure 6.

The columns of the matrix designate institutional objectives. Associated with each column heading is the value indicating the successful percentage of the total student population. The rows indicate instructional objectives of a program. The associated value indicated the successful percentage of students enrolled in the pro-

Cost Matrix

Institutional Objectives

		a	b	c	d	
	1	$5500	$4400	$2200	0	
Programs	2					
	3					
	4					

Sum _____ _____ _____ _____

Figure 5

gram and who were tested on the instructional objective. The squares contain two numbers. The first is an indication of the percentage of students who were tested on the instructional objective and who were successful on the institutional objective criterion. The second number is similar to the first, but the student population is limited to a subset of the previous population. The percentage indicates successful students who are not enrolled in other programs which have instructional objectives related, either in a planned or contributory role, to the same institutional objective.

Another matrix which would be beneficial to a study of available data should be similar to the three dimensional cost matrix presented earlier. Instead of the third dimension being instructional programs, it could be the instructional objectives of the instructional program. For some cases the assignment of cost to instructional objectives may be easily achieved, but the probability of having to subjectively assign some cost factors is high. Therefore, a procedure similar to methods previously described would have to be designed. Once data is available in the above form it would be easy to generate a cost matrix relating instructional objectives to institutional objectives. This matrix would be similar to the matrix illustrated in Figure 5, except the rows would designate instructional objectives instead of instructional programs.

To complete the collection of data, it is suggested that a table of instructional programs be compiled which would list the total cost of the program and the level at which each program is funded. The

Achievement Matrix

Institutional Objectives

Instructional Objectives

	a(73)	b(84)	c(91)	d(87)	
1(84)	77, 56	85, 83	92, 92	86, 84	
2(79)					
3(86)					
4(92)					

Figure 6

level of funding could be determined from data generated by planners of instructional programs if requests for funds for programs were submitted in a format which would indicate different levels at which the program could operate.

The set of matrices and the table suggested for categorizing and displaying data would provide the analyst with a vast amount of data. The collection of data would be a time-consuming and sometimes difficult task. The study as defined would certainly require the application of data processing methods. Computer programs could be designed which would aid in the categorization of the data and would generate the displays in the suggested formats.

The third level of operation in systems analysis--the analysis of the data--is limited only by the imagination of the explorer. Working within the constraints of the validity of the subjective data, it would be possible to draw inferences and in some cases test hypotheses.

The purpose of this chapter has been to develop a framework for the analyses of cost-effectiveness relationships of instructional programs in vocational education. The completion of the proposed collection and display of data would provide the information necessary to design guidelines for a cost analysis of instructional programs.

CHAPTER SIX

PHASE IV:

EVALUATION OF VOCATIONAL-TECHNICAL EDUCATION

(Impact Study)

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The impact study will basically be concerned with ascertaining the degree to which the Vocational-Technical Education effort is meeting the needs of the Commonwealth of Massachusetts. Since the needs are multi-dimensional in nature, several programs of study will be directed toward the examination of impact. Since the impact studies will generally deal with decisions of long-term importance, rather than decisions producing immediate value for program modification, these studies will be scheduled intermittently in the development cycle of the evaluation and will be discussed below in general terms.

The impact study has four components, namely: 1) a state-wide survey of occupational needs, 2) a compilation of state-wide statistics on enrollment and matriculation from vocational and technical school, 3) several research samples designed to study employment in areas of training, job satisfaction of graduates, citizenship and social behavior of graduates, and aspirations of potential graduates, and 4) a small sample longitudinal study of program graduates done in a case-study manner.

The state-wide survey will include the development of a questionnaire which will be sent to a random sample of major industries. This survey will seek employment and development information which may prove helpful in program planning for vocational-technical instruction. Additional knowledge on occupational needs in the state will be sought from other state employment agencies whose data bases offer potential enlightenment for program planning. Several sources, including parents, students, educators, social workers, and economists will be surveyed to provide perspective to the industrial and employment agency surveys.

The compilation of state-wide statistics on enrollment and completion of vocational-technical school programs for the Commonwealth of Massachusetts is currently in progress. This report will further demonstrate the total impact of the program for the state; it eventually will include a catalog of vocational-technical offerings, economic data on how vocational-technical graduates compare with other educative program graduates, the data comparing the state vocational-technical expenditures with those of other states, and growth figures.

Two forms of analysis will be utilized to ascertain results in terms of over-all vocational-technical programming goals. Random samples of students will be followed after program completion and measurements of their success on several variables will be made and compared either to state norms or to non-equivalent control groups. These include job-satisfaction, life-adjustment, personal asiprations, and work records. A second form of evaluation will consist of direct measurement of a multi-dimensional basis of the stated general goals of vocational education. For example, citizenship training might be measured in terms of several traits or variables, such as voting registration and participation, civic club membership, credit records and police arrests. In this instance, non-equivalent control groups selected by matching age, race, and socio-economic status will form the basis for comparison.

General program goals and impact employing a case-study methodology on a longitudinal basis will also be studied. A small random sample of beginning students will be selected and biographic records and diagnostic test files will be developed on each student. Teacher and counselor reports on the sample study will be collected monthly. For each subject, general standardized tests and indices which seem pertinent to the goals under consideration will be administered and recorded. Throughout the vocational-technical school careers and several post school years, the sample subjects will then be studied.

CHAPTER SEVEN

EVALUATION, ACCREDIATION, AND THE MASSACHUSETTS INFORMATION FEEDBACK SYSTEM

A Commentary

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The purpose of this chapter is to discuss relationships between the accrediation process and the Massachusetts Information Feedback System. Within this presentation we will define accrediation as the endorsement of educational conditions, procedures, or programs by an authoritative group in light of published criteria or standards. We will narrowly define evaluation to mean both the description and judgment upon educational conditions, procedures, or outcomes. A precondition to evaluation is the process of measurement which is the quantification of conditions, procedures or outcomes, and is a process requirement before value judgments can be made. Measurement is a part of the description phase of the evaluation process.

The Massachusetts Information Feedback System has been thoroughly described in this publication. This system seeks to feed back information to both the local and state levels regarding achievement of pupils on specific behavorial objectives developed in the various vocational schools; it seeks to describe relationships between various teaching processes within the school and achievement (process-product evaluation); it seeks to describe the cost relationships between institutional objectives, instructional programs, and measures of achievement of objectives; and it seeks to describe the total impact of vocational education on the Commonwealth. In short, the Massachusetts Information Feedback System attempts to provide a data base for a systems approach management to vocational education. The system does not attempt to restructure vocational education across the state and is extremely respectful of both local control, and existing state/local relationships within vocational education. In the language of this chapter, the Massachusetts Information Feedback System objectively measures various aspects of the conditions, procedures and outcomes of vocational education and thereby describes vocational education in such a way that value judgments can be made frequently at all levels. Evaluation within the Massachusetts Information Feedback System is conceived of as an on-going process with information being fed back semi-annually.

Accreditation, the process of endorsing educational conditions, procedures, or programs, relies upon a description and measurement process for evaluation which is different than the procedures used by the Massachusetts Information Feedback System. Essentially, the the accreditation process relies upon the collective judgments of an authoritative peer group of a particular educational program, in light of published criteria or standards. These standards are usually modified to reflect the objectives of a local educational program.

Accreditation may involve a total school or a part of a total educational setting, as illustrated by an association's examination and accreditation of a program in business, data processing, engineering, or teacher education. Accreditation activities are more often directed towards means rather than ends. Means, conditions, and procedures are observed and judged regarding their extensiveness and effectiveness. Judgments are made by self or visiting committee evaluation teams regarding the environment for learning, the activities contributing to learning, and the enthusiasm for the learning situations by the learners and those responsible for directing the learning.

The accreditation process may reflect activity by professionals over a significant period of time. For some school staffs one year's in-service activity may be directed toward the self-evaluation aspects of the accreditation study. Numerous committees may be developed to examine and report on specific education services (guidance, library, administration), or curricular fields (science, language, music).

Self-evaluation committees preparing for visitation by a peer group of professionals might spend 50 to 100 hours reviewing evaluation guides or check lists designed to provide some basis for judging the effect of the significant conditions and procedures operating within a school. Such periods of in-service activity are generally followed by two- or three-day visits by an official committee representing an accrediting association or state agency. Self-evaluation committees may involve all professional personnel in the school or program being studied or may be representative of the various facets of the institution. Visiting committees may be limited to two or three people representing the accreditation group or may be expanded to about twenty-five percent of the staff of the school being studied.

Professional organizations reflect two points of view with reference to their accreditation responsibilities. Their concern is either the accreditation of the total institution or a specific program or curriculum within the institution. Associations accrediting specific programs are the National Council for Accreditation of Teacher Education (NCATE) or the Accrediting Commission for Business Schools. Such general associations as the Regional Association of Colleges and Secondary Schools, of which there are seven distributed geographically throughout the United States, represent groups which accredit schools at the secondary level or institutions of higher education.

As a rule, reports emanating from a visiting committee for accrediting associations are quite general in tone and usually identify recommendations and commendations regarding particular facets of the educational program for which a sub-committee has some responsibility. A trend has been exhibited during the last two decades for accrediting standards to become more general and flexible, reflecting standards which are more qualitative in nature. Such change in accrediting standards has been brought about because of the occasionally questioned validity of specific quantitative standards and with recognition of the inability of accrediting groups to develop single sets of criteria to meet all conditions or educational settings. As continued attention has been given to the accrediting process and as a very high percentage of schools and institutions have become accredited, standards for accreditation have become interpreted as minimal and educators interested in achieving goals beyond accrediting levels have sought a more objective description of programs.

The relationships between the Massachusetts Information Feedback System and the accreditation process are one of mutual support. It would seem reasonable to predict that, in the future, accrediting associations will rely heavily upon the information produced by a total educational information system. That is, the information produced by a total educational information system will constitute an objective data base by which an accrediting association can evaluate and endorse an education program. A total educational information system provides an empirical base for directed and controlled educational change. This information will become essential in the modification of existing vocational-technical educational programs. We would expect that accrediting agencies would consider the program modification process initiated by the local educational program in light of an information feedback system as a part of their total evaluation of a local educational program.

Both accreditation and an educational information feedback system are essential parts of the total educational process. An educational information feedback system seeks to provide information about the total educational process. It describes relationships between measured components of the total educational process, reports on the effectiveness of education, and provides the data base for directed change and program modification. It is an essential planning tool. On the other hand, accreditation is a process of endorsing a particular school or program as being consistent with or better than established standards. Surely, the accreditation process will be more meaningful when more sophisticated techniques of measuring and describing vocational-technical educational programs become operative. The implementation of the Massachusetts Information Feedback System, or similar total educational information systems should provide a base to make accreditation a more meaningful process.

ADDENDUM

ADDENDUM

Progress in the Development of the System

Beginning in December, 1968, when the Research Initiation Team of Vocational-Technical Education for the Commonwealth of Massachusetts identified evaluation as a priority concern, the Research Coordinating Unit proceeded to clarify the needs of evaluation in vocational education. Several individual meetings with selected members of the Research Initiation Team and with a consulting staff from the School of Education, at the University of Massachusetts, led to the identification of needed feedback on vocational-technical programming. Consequently, a systems approach to the evaluation of vocational-technical education was developed, but due to the vastness of the project and the clear evidences of much needed training prior to implementation of this system, it was broken down into stages. Each stage, like the total system, was then conceived to be a developing project and task analysis was utilized to decide optimal starting points.

Since the individual program assessment was designated as the most needed feedback, since the provisions designed to allow local autonomy in curriculum control in individual program assessment created the greatest number of logistic problems, since data from individual programs was needed in almost every phase of the evaluation system and since behavorial objectives were necessary for individual program assessment, the total system was started by introducing a six school pilot program at the Annual Winter Conference of Vocational-Technical Education at Auburn, Massachusetts, February, 1969. The six pilot schools will be operational during the 1969-70 school year.

A workshop on objective writing and a follow-up conference were held in April, 1969, at Northampton, Massachusetts. Each of the six pilot schools designated three facilitators who attended the workshop to prepare them for the coordination roles of developing behavioral objectives for the programs at their schools. Currently, these men are developing the objectives and the Research Coordinating Unit is planning the test development procedures.

The conference schedule at Northampton included the following sessions:

What is Evaluation?
What are Behavioral Objectives?
Occupational Analysis and Behavioral Objectives
Small Group Work Session--Objective Writing
Introduction to Taxonomies as a System for Classifying Behavioral Objectives
Review: Task Analysis, Taxonomies, and Behavioral Objectives
Review: Total Evaluation Information Feedback System
Introduction to Simulated Objective Writing
Conference Participants Develop Objectives Under Simulated Conditions
Process-Product Evaluation
Simulated Objective Writing
The Relationships Between Evaluation for Accreditation and Evaluation as an Information Feedback System: a panel discussion

The conference participants and staff were:

Don Glazier	Animal Science	Essex Agr.& Tech. Inst.	Hathorne
Dick Churchill	Plant Science	Essex Agr.& Tech. Inst.	Hathorne
Dave Twonley	Forest Resources	Essex Agr.& Tech. Inst.	Hathorne
Russell J. Booth	Machine Shop	Diman Regional	Fall River
Edward Peckham	Animal Science	Smith's Agr.& Voc.	Northampton
Frank Shore	Basic Electronics	Haverhill Trade	Haverhill
Gerard B. Lachance	Electronics	Diman Regional	Fall River
Henri J. Pare	House & Mill	Diman Regional	Fall River
Jim Boland	Electrical	Haverhill Trade	Haverhill
Edward Vandoloski	Electrical	Smith's Agr.& Voc.	Northampton
John Filipek	Auto	Smith's Agr.& Voc.	Northampton
Robert P. Nelson	Technical Coor.	Blue Hills Reg.	Canton
Arthur Vuilleumier	Elect. Tech.	Blue Hills Reg.	Canton
David Malone	Math & Science	Blue Hills Reg.	Canton
Michael J. Mango	Auto Mechanic	Chicopee Compr.	Chicopee
Quinto Cimma	Welding	Chicopee Compr.	Chicopee
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